US EPA Mid-Continent Ecology Division

Research Project Summary

Evaluation of Toxicity and Accumulation of PFOS by *Rana pipiens*

Overview

A host of fluorinated surfactants increasingly are being used for a variety of applications. Concern for the potential toxicological risk of these types of chemicals had been minimal until recent documentation of the extensive distribution in both humans and wildlife of perfluorooctane sulfonate (PFOS), the primary degradation product of a commonly-used class of sulfonyl-based fluorochemicals originally manufactured by 3M. There is some information, primarily from rodent studies, concerning the potential developmental, reproductive, and systemic toxicity of PFOS. It appears that aspects of early development are quite sensitive to the effects of PFOS; however, comparatively little is known about its toxicity in wildlife. This is of particular concern given the relatively high concentrations of PFOS that have been reported in mammals, birds, and fish from locations throughout the world. Exacerbating this lack of information is the fact that the actual toxic mode/mechanism of action (MOA) of PFOS is unknown, so extrapolation of effects from rodent studies to wildlife of concern is uncertain. Further complicating assessment of the ecological risk of fluorinated chemicals in general and PFOS, in particular, are their unique physico-chemical properties. For example, historically-used models, developed primarily for nonionic organic chemicals, are of limited utility with respect to predicting the distribution and effects of these chemicals either in the environment, or within individual animals. In addition, existing test methods with aquatic species may not suffice for evaluating fluorinated chemicals in terms of traditional approaches for chemical delivery.

The overall objective of studies associated with this area is to develop techniques for assessing the ecological risk of fluorinated organic chemicals, initially utilizing PFOS and related products as prototypical representatives of this class of compounds. This work would complement ongoing and planned studies with PFOS conducted in the Research Toxicology Division of NHEERL. A critical aspect of the research conducted at MED will be identification of biological models (species, life stages, endpoints) that effectively reflect both conditions of the greatest sensitivity to PFOS, and result in data of utility for predicting population-level effects. This work will examine reproduction and development in a small fish model (fathead minnow) and development in amphibians (*Xenopus*, native North American ranids). Toxicology studies will be conducted with careful attention to dosimetry issues (uptake, metabolism, distribution) to enhance development of credible exposure approaches, as well as support derivation of models suitable for extrapolation across species. Characterization of dosimetry under controlled conditions will be complemented with hypothesis-driven analyses of key environmental samples to facilitate extrapolation from the laboratory to the field. We also will attempt to gain insights as to toxic MOA of PFOS through the use of DNA microarrays. An understanding of MOA would not only enhance extrapolation of effects across species, but could directly support the development of in vivo endpoints and/or in vitro systems that could be utilized to obtain data for structure-activity relationship (SAR) models suitable for hazard identification.

Key Products

Journal article on analytical methods for determination of PFOS in water and tissues. Kuehl et al. (In preparation)

Journal article on toxicity and bioconcentration of PFOS in the northern leopard frog. Ankley et al. (In preparation)

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